Enhanced absorption of solar radiation by horizontal variability of cloud microphysics

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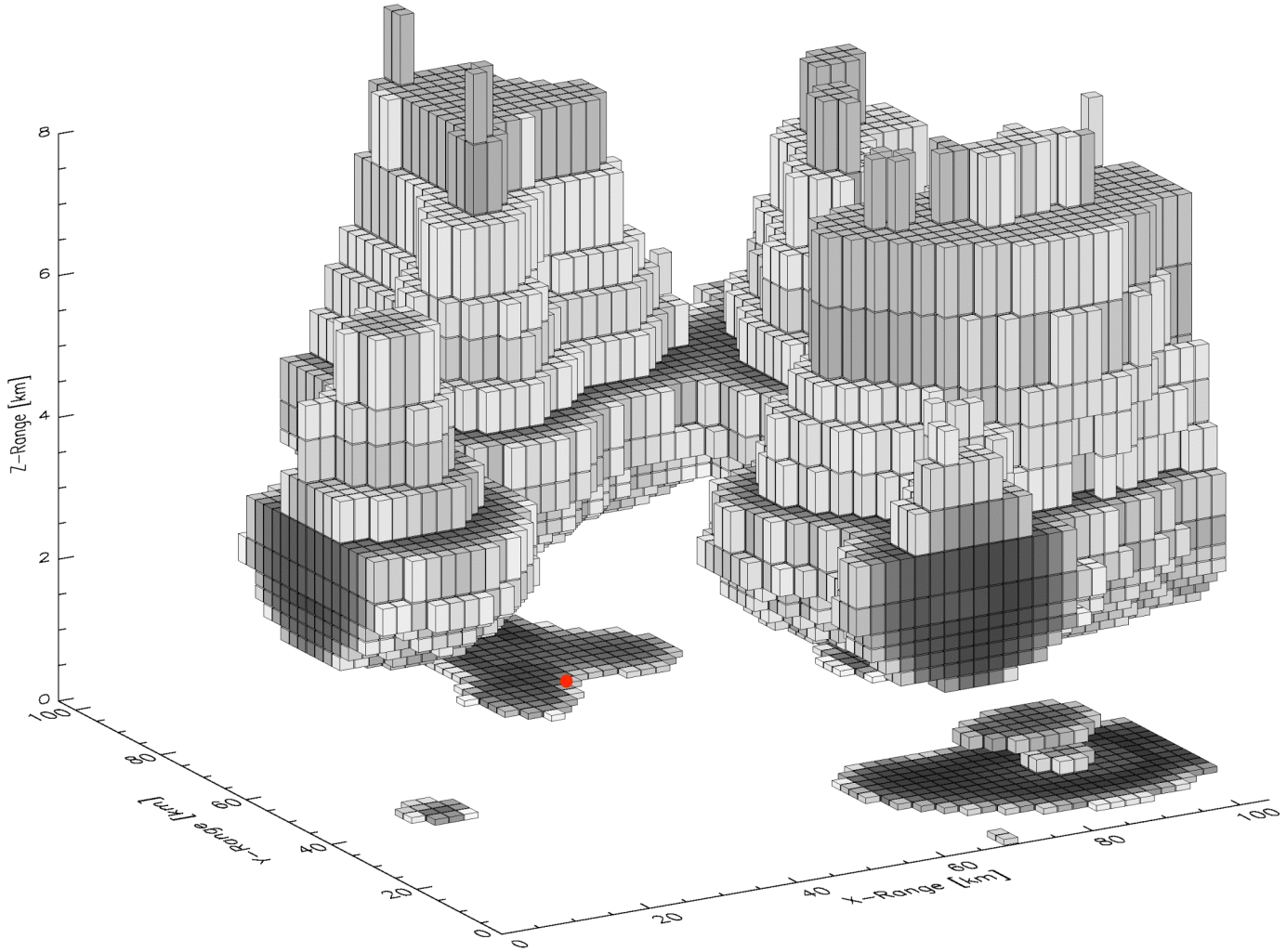
GESIMA: 3d, non-hydrostatic, bulk cloud physics

cloud water, rain, ice, snow/graupel



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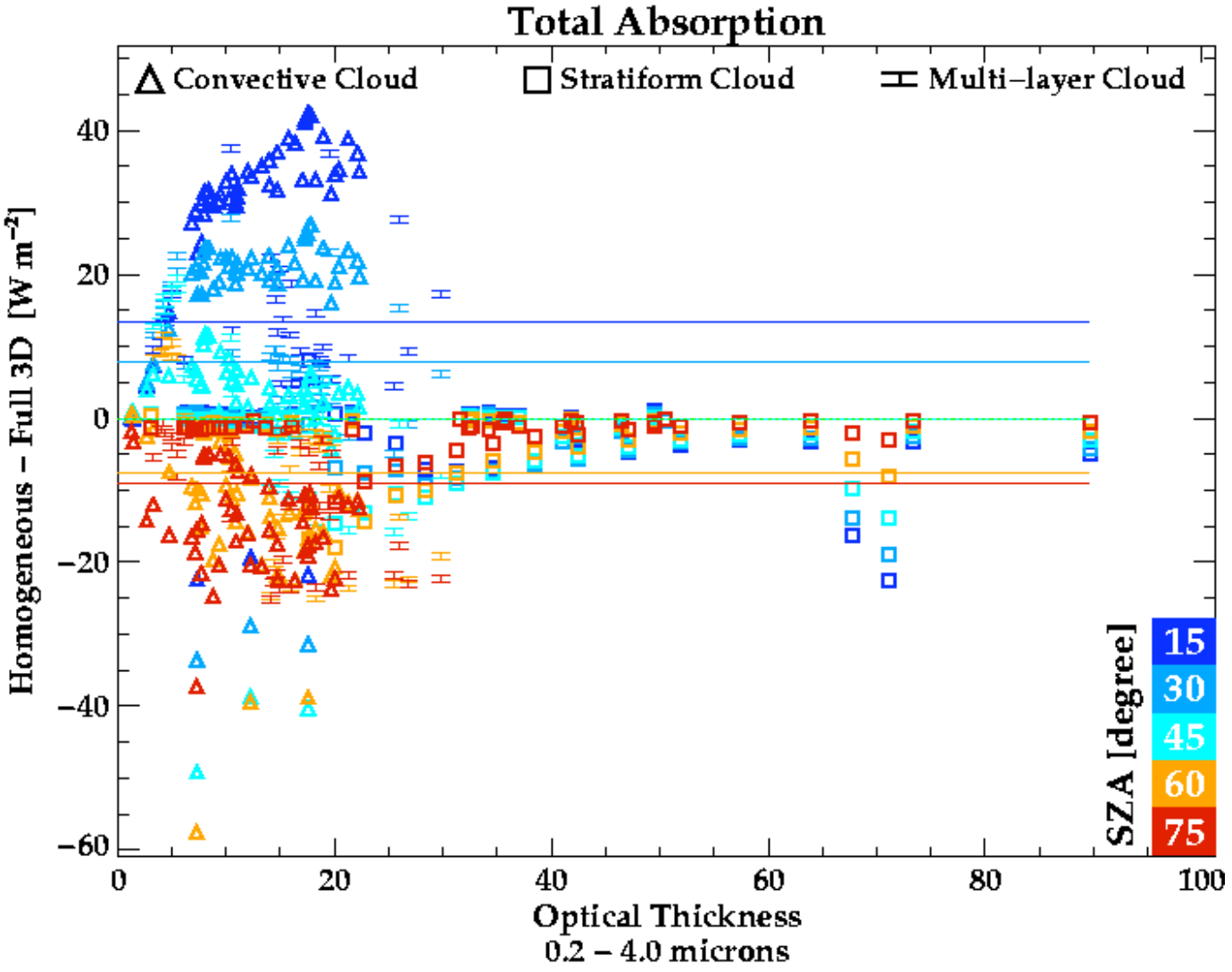
Absorption: PPHOM – Full 3D



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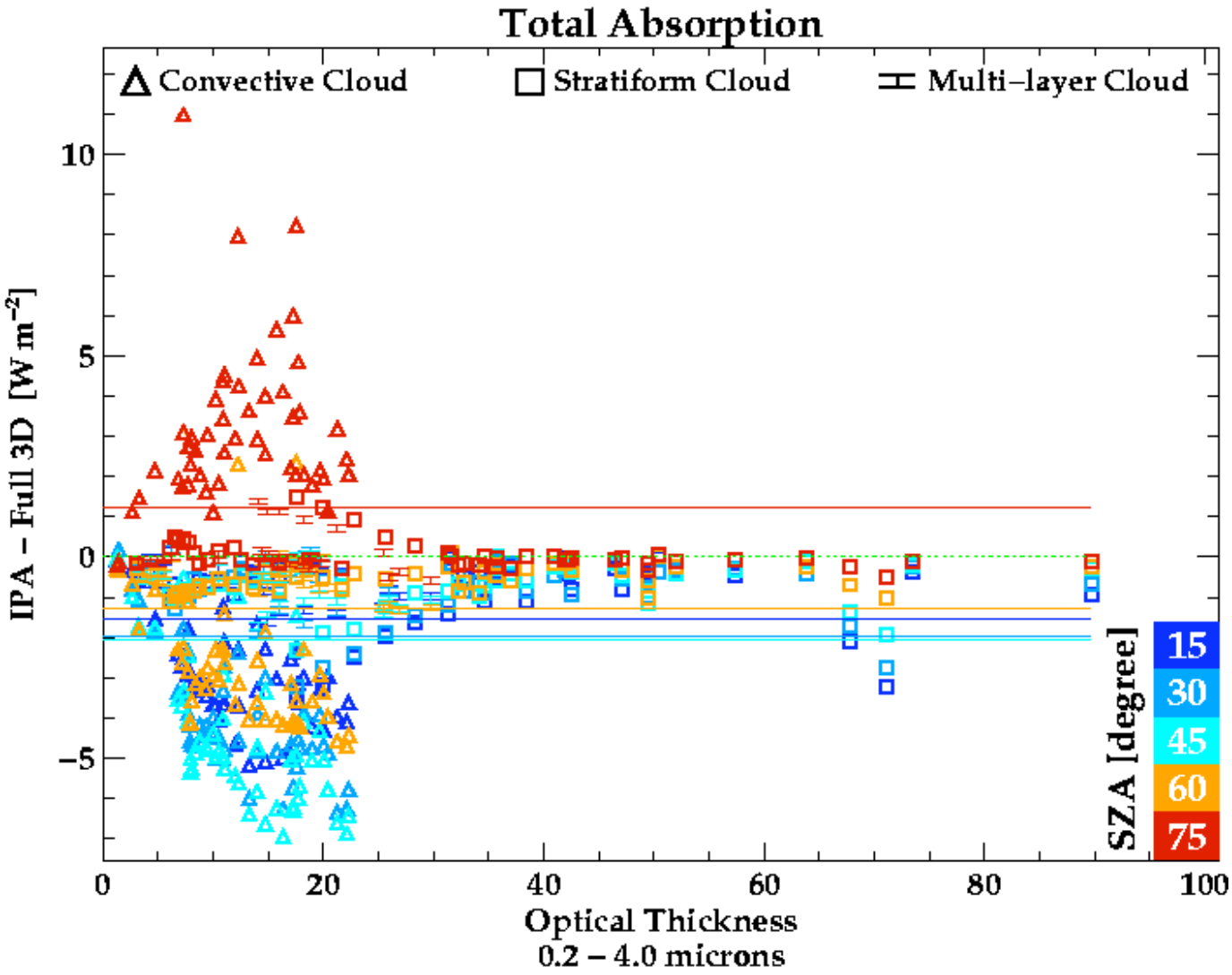
Absorption: ICA – Full 3D



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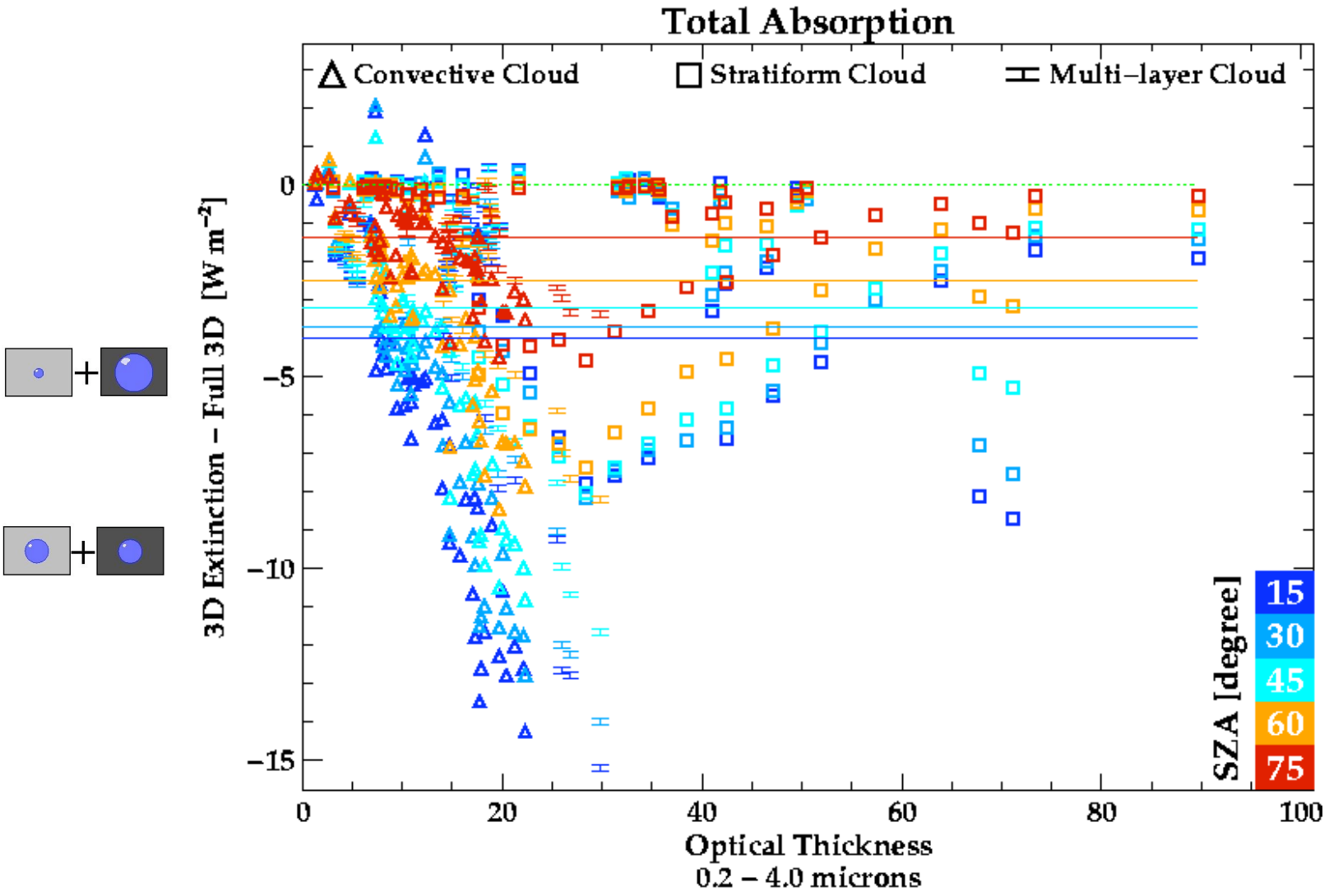
Absorption: (3D-ext, 1D-scat/abs) – Full 3D

horizontally homogeneous microphysics – full 3D



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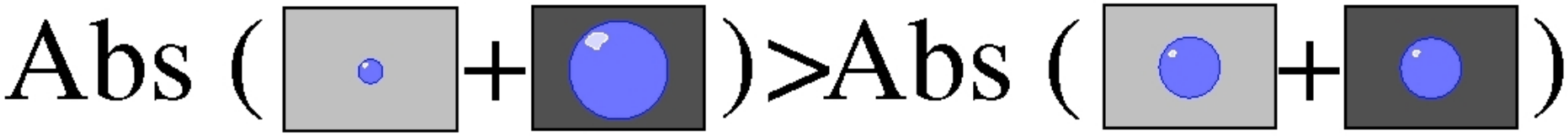
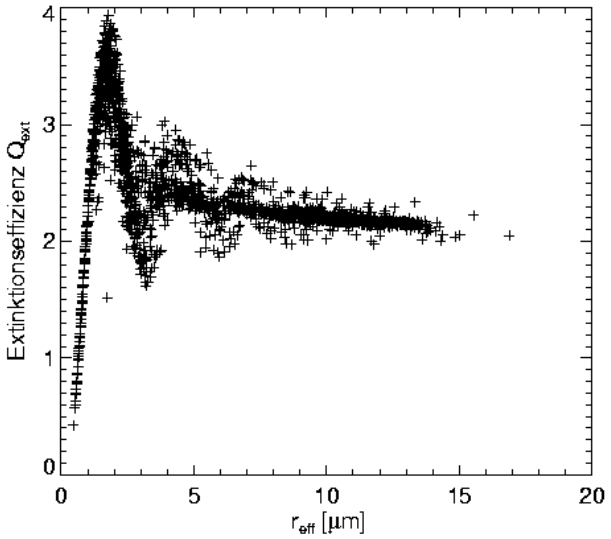


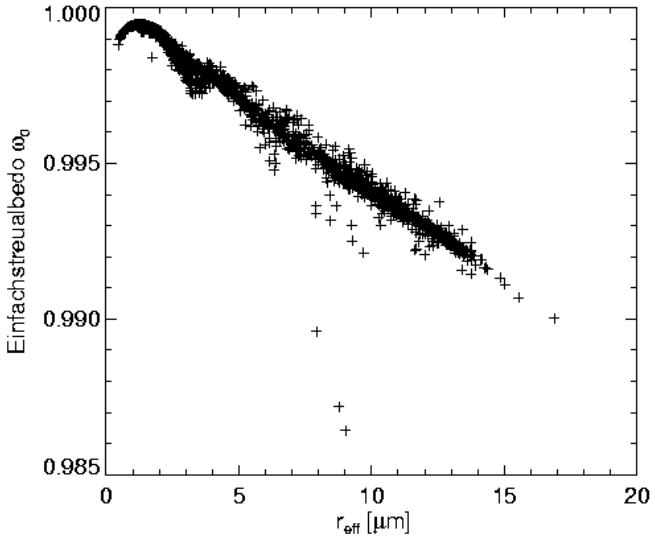
mean bias:
1.2 Wm^{-2} ($\theta = 75^{o}$) - 4.0 Wm^{-2} ($\theta = 15^{o}$)

cloud microphysics effect on absorption...

- ...increase with decreasing solar zenith angle (deeper penetration of solar photons into the cloud)
- ...decrease with increasing solar zenith angle (less horizontal transport into higher absorbing regions)
- ...depend on horizontal variability of particle size

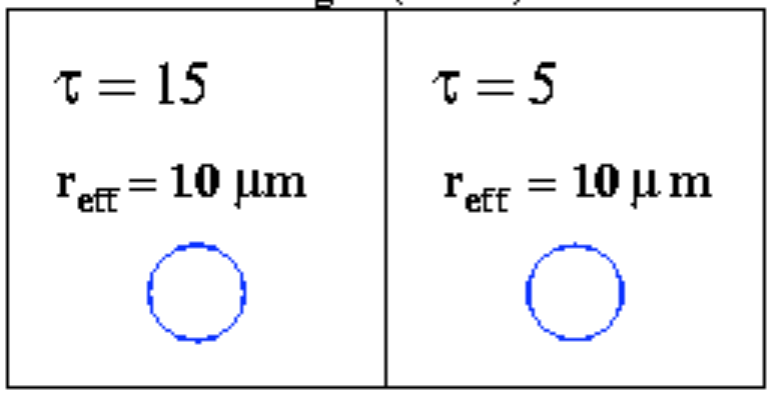
Variability of water cloud optical properties



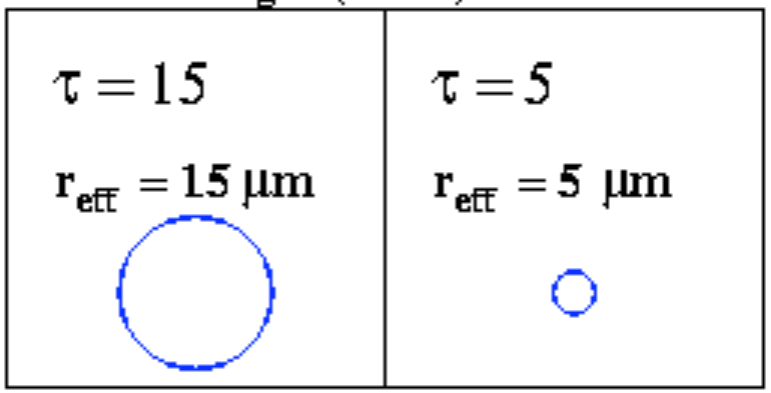


Vergleich 1:

Homogen (Fall 1)



Inhomogen (Fall 2)

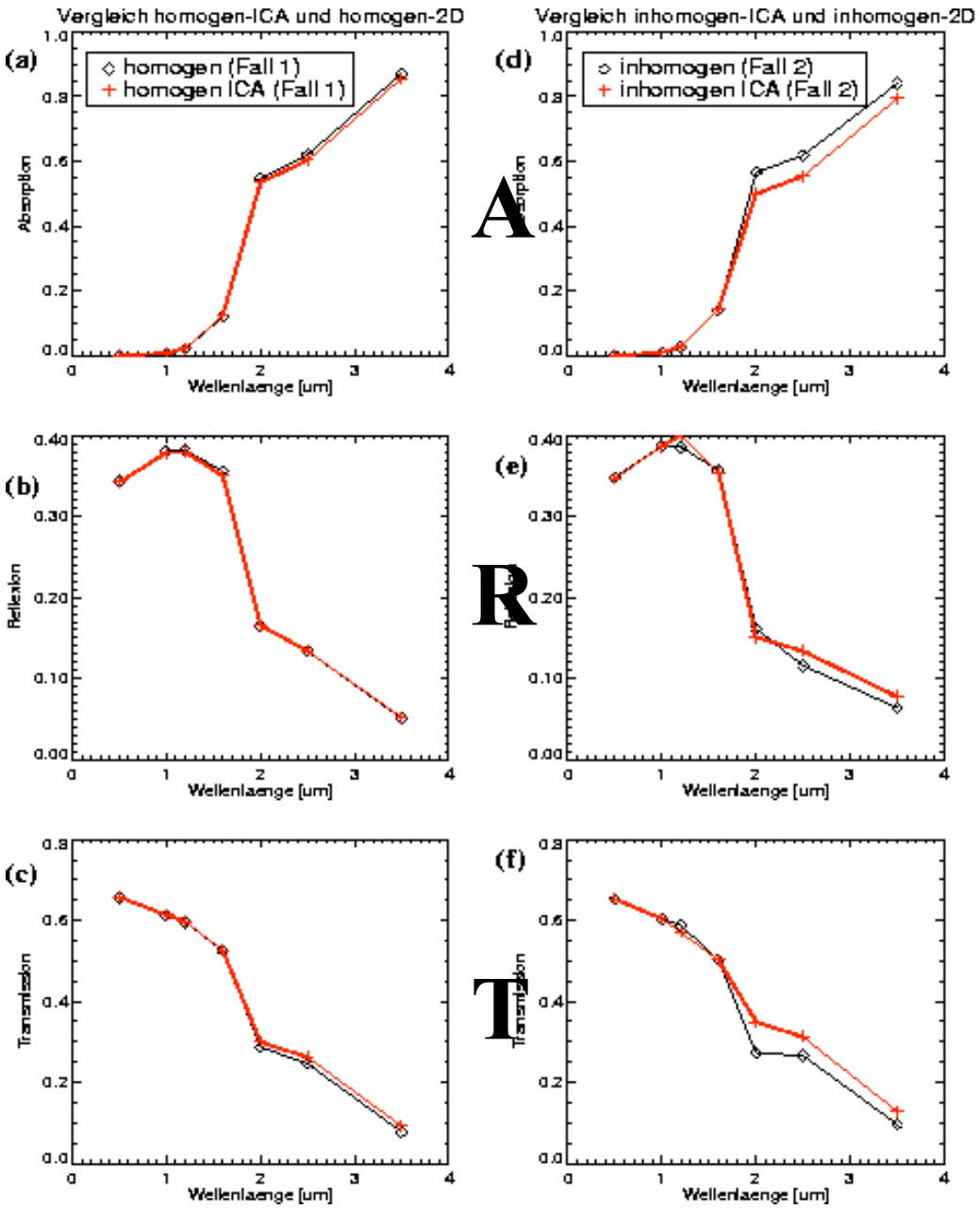


hom. μΦ:

2D

vs

ICA



inhom. μΦ:

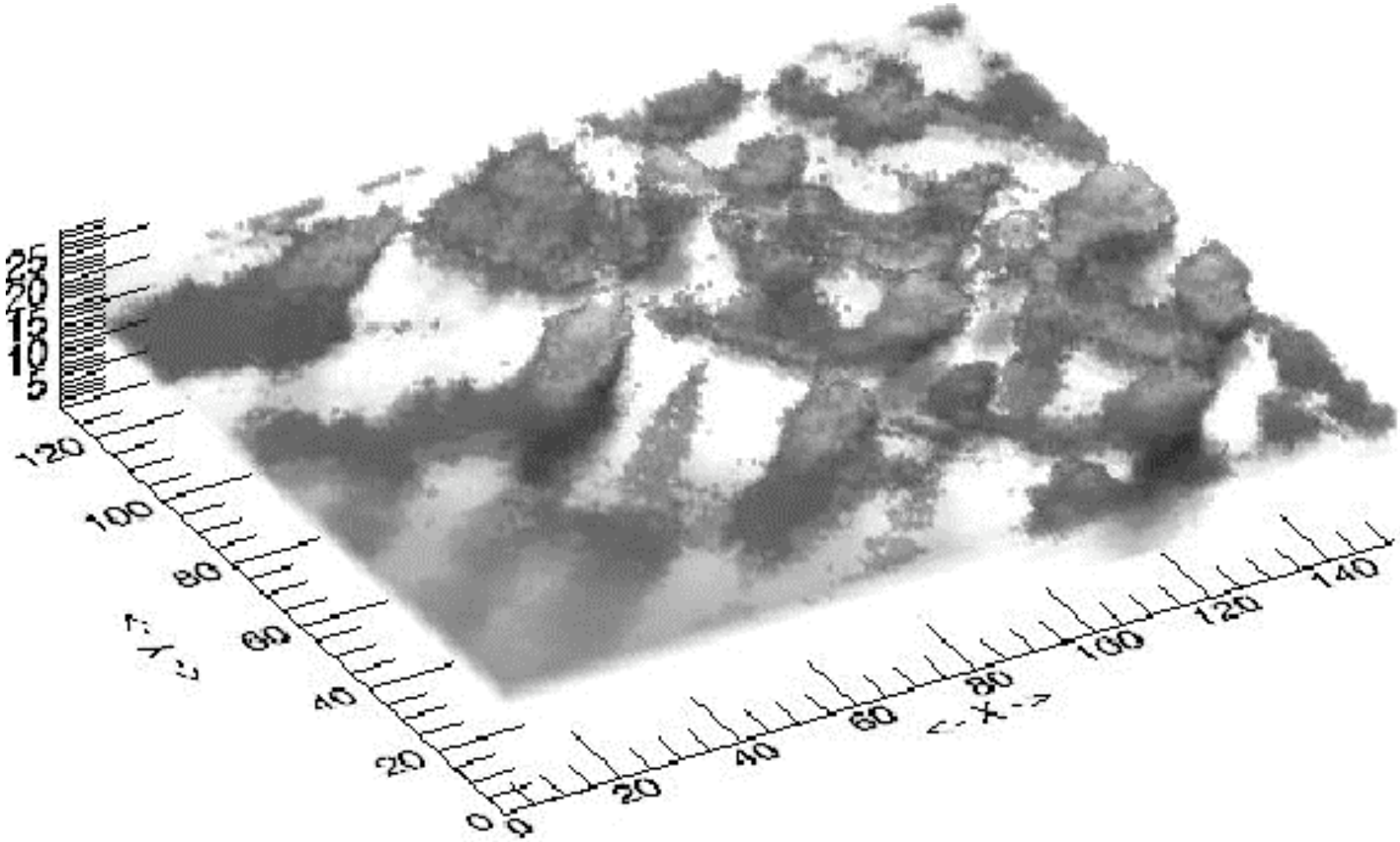
2D

vs

ICA

CLABAUTAIR Cloud (Ronald Scheirer)

CLoud liquid w**A**ter content and effective radius retrieval **B**y an **AU**tomated use of **AIR**craft measurements



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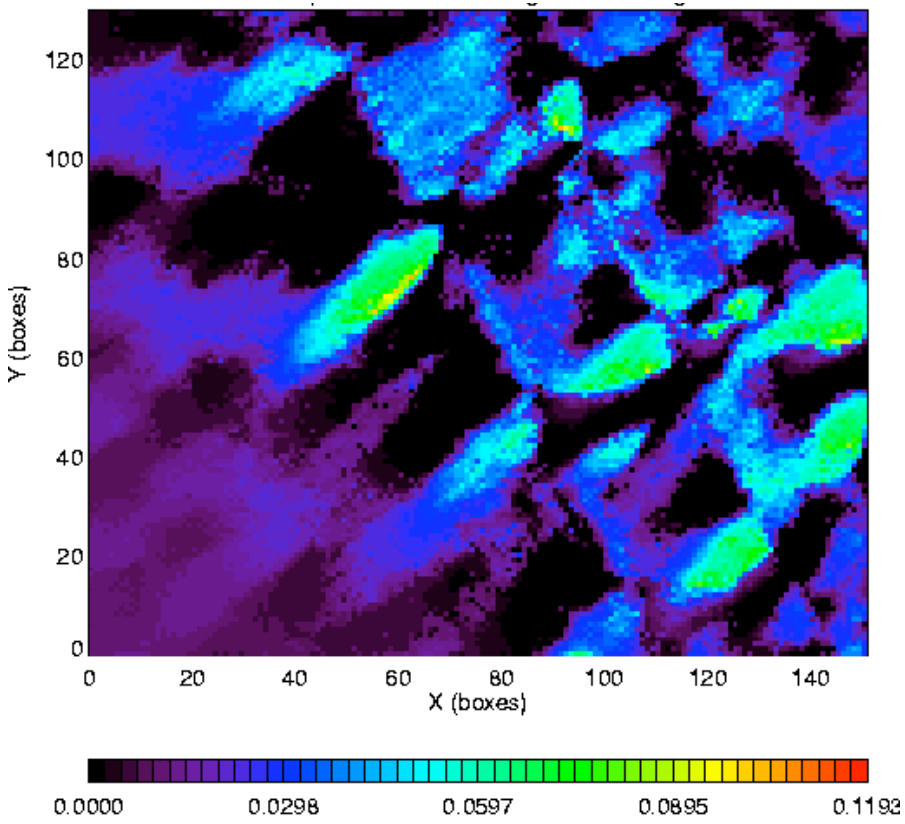
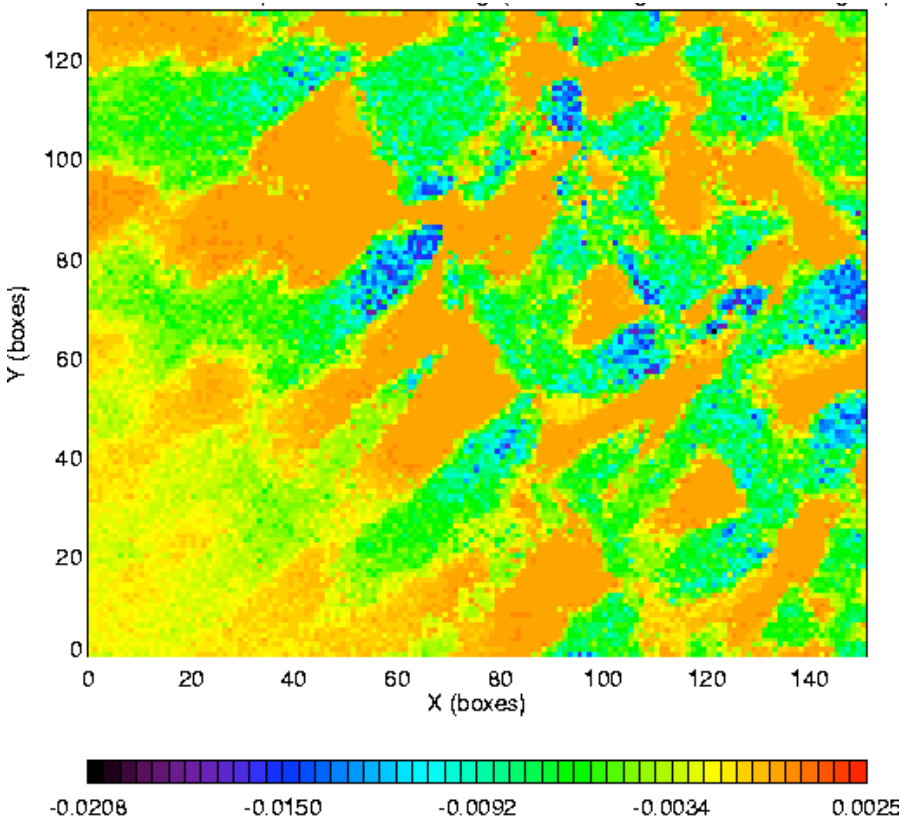
Solar broadband absorption

3D cloud with horiz. hom. μϕ



Absorptivity

Difference: hom μϕ – inhom. μϕ



Absorptivity

Absorption and Horizontal Transport